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ABSTRACT

Scripted cooperative learning and individual learning of descriptive information were compared in a 2-x-2 factorial design with 104 undergraduates. Influenced by models of individual learning and cognition, differences were assessed in (1) information acquisition and retrieval, (2) the quality and quantity of recalled information, and (3) the nature of the recalled information. Overall, dyads (pairs of cooperating students) outperformed individuals in individual recall performed immediately after studying and after a 2-day delay. Results indicate that: (1) dyads demonstrated improved learning at the encoding (acquisition) stage of processing, (2) the quality of recall was similar although pairs recalled more propositions, and (3) dyads remembered more micro propositions, but not more macro propositions. It is hypothesized that cooperation between dyads results in a joint focus on the details of information. Three tables, one figure are included. (Contains 23 references.) (Author/SLD)

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Toward a Science of Cooperation

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Abstract

Scripted cooperative and individual learning of descriptive information were compared in a 2 x 2 factorial design. Influenced by models of individual learning and cognition, differences were assesed in (a) information acquisition and retrieval; (b) the quality and quantity of recalled information; and (c) the nature of the recalled information. Overall, dyads (pairs of cooperating students) outperformed individuals in individual recall performed immediately after studying and after a two-day delay. Results indicated that: (a) dyads demonstrated improved learning at the encoding (acquisition) stage of processing; (b) the quality of recall was similar although pairs recalled more propositions; and (c) dyads remembered more micro propositions, but not more macro propositions. It is hypothesized that cooperation between dyads results in a joint focus on the details of information.

Toward a Science of Cooperation

Cooperative learning is a well known method of acquiring knowledge or skills in which equal status individuals interact to enhance their individual performance. Cooperative learning can be contrasted with tutoring and team training. Tutoring involves a distinction in status among the participants (expertise) and team training focuses on the enhancement of team or group outcomes rather than individual outcomes normally associated with cooperative learning. The history of research in cooperative learning extends over some 90 years and 600 studies (Johnson, Johnson, & Smith, 1991) although the majority of work has mostly involved only school children and has been conducted as field studies rather than controlled laboratory experiments.

The general advantage of cooperation over individual study has been shown in numerous studies with several reviews and annotated bibliographies reporting increases in general cognitive outcomes, such as higher academic grades or scores on standardized tests (Johnson & Johnson, 1989; Nastasi & Clements, 1991; O'Donnell & Dansereau, 1992; Sharan, 1990; Slavin, 1983; 1992; Totten, Sills, Digby, & Russ, 1991). Although the evidence from most studies generally support the positive impact of cooperation (e.g., Webb, 1982; 1989), much of the research is demonstrational rather than analytic in nature. The result of this condition is a lack of clear understanding about why or how cooperation works (O'Donnell & Dansereau, 1992). More precise knowledge of various aspects of interactive learning and cognition will allow us to better predict when cooperative activities will be effective, provide a basis for diagnosing and improving cooperatives scenarios and enhance the development of more analytic

models of cooperative learning.

Scripted dyadic cooperation is a well established cooperative learning technique chosen as the focus of the present study partly because it has evolved from experimentally investigated models of individual Dansereau, et al., 1979) cognition and learning (Dansereau 1985, 1987, 1988; Dees, Dansereau, Peel, Boatler, & Knight, 1991; O'Donnell & Dansereau, 1992; O'Donnell, Dansereau, Hall, & Rocklin, 1987; Patterson, Dansereau, & Newbern, 1992). Scripted cooperation involves two individuals who are given a cognitive-based script to guide their interaction over a complex body of information (see Figure 1 for an example of a cooperative script). The most common dependent measure is an essay or free-recall test which asks participants to write down everything they can remember from studying. The recall is then scored according to a predetermined key which reduces the study materials to a complete set of individual idea units or propositions. Values are assigned according to the correctness of the statements and summed to compute the total recall score. The number of propositions recalled by an individual can be totaled as a "mentions" score. The total recall score can then be divided by the mentions score to produce an "accuracy" score. The recalled propositions can also be categorized into main ideas (macrostructure) and detailed ideas (microstructure). These four types of variables offer evidence about the quality (accuracy), quantity (mentions), and type (microstructure and macrostructure) of information that is recalled from interactive learning episodes. The assessment of cognitive outcomes is a major focus of the present experiment.

Prior research in scripted cooperation has explored isolated dimensions of cognitive

outcomes. For example, one study has compared micro and macro structure, reporting that dyads were superior to individuals in the recall of main ideas (Spurlin, Dansereau, Larson & Brooks, 1984). Another study analyzed the free recall mentions scores, reporting that dyads outperformed individuals (McDonald, Larson, Dansereau, & Spurlin, 1985); while another study reported no differences in recall mentions for individuals and dyads in learning concrete procedures (O'Donnell et al, 1988). Finally, the accuracy and mentions of individual and dyadic recall have been analyzed within the same study, indicating no differences in recall accuracy but superior performance on mentions by dyads (Hall et al, 1988). Clearly, a comprehensive comparison of cognitive outcomes seemed to be in order.

Another issue regarding the outcomes of cooperative interaction is related to the locus of the impact of cooperation. This topic has not been investigated and seems to deserve consideration. If cooperation results in a more thorough acquisition of information, the differences between cooperation and individual study should appear in both immediate and delayed measures. If the impact is not on increased acquisition but improved retrieval, there should be less difference on immediate measures when retrieval demands are lower than on delayed measures when retrieval demands are higher.

The objectives of the present study were to comprehensively assess cognitive outcomes and examine the locus of cooperative impact. The empirical objectives are expressed in the following questions:

1. Is dyadic learning more effective than individual learning (a replication of previous findings)?
2. Does dyadic learning impact on acquisition processes, retrieval processes, or both?
3. Does dyadic learning influence the amount/quantity of recall, the accuracy/quality of recall, or both?
4. Does dyadic learning impact on the type of information recalled; that is, the micro propositions, macro propositions, or both?

The experimental design developed to explore these questions was a group-type (dyads versus individuals) by recall (immediate versus delayed) factorial design. Comparisons were made of participants recall performance which occurred either immediately after their (individual or dyadic) study of information or after a two-day delay.

Method

Participants

One hundred four Texas Christian University college students were given extra credit in their undergraduate psychology classes in return for their participation in this experiment.

Materials

Scripted cooperation instructions. A set of written instructions explained the various roles and duties to serve as a guide for participants during the dyadic interaction. The two main roles were teacher/presenter and listener/elaborator/corrector. Each

participant was to enact each role for one-half the study time.

Study passage. An approximately 1500 word passage on the effects of cocaine on the human body was used. The passage was marked at the halfway point so that participants could switch scripted cooperation roles.

Free-recall test. Participants completed a free-recall test which required them to write down as much information as possible from the text passage.

Procedure

The experiment was held in two sessions with a two day interval between sessions. Participants were randomly divided into four groups: Individual/immediate recall (n=24), Individual/delayed recall (n=26), Dyad/immediate recall (n=29), and Dyad/delayed recall (n=25). In the first session the cooperative learning instructions were read and briefly explained. A 25-min study period of the passage was followed by an immediate recall for the immediate groups and a filler task for the delayed groups. The delayed testing condition occurred two days later while those in the immediate groups completed the same filler task. The free-recall test at both sessions lasted 20 minutes.

Results

First, scoring procedures and reliabilities are presented, then the results of the analyses related to the empirical questions are described.

Scoring

The free-recall test was scored by a trained rater according to pre-determined keys without knowledge of group affiliation. A propositional scoring technique was used that was developed by Meyer (1975) and modified by Holley, Dansereau, McDonald,

Garland, and Collins (1979). First, the passage was divided into an inclusive set of single idea units stated in a simple declarative sentence. The rater then matched the participant's recall with the established key. Depending on the accuracy of the match, the participant received a score up to four (completely accurate); omissions received a zero. A second experienced rater randomly scored 12% of the free-recalls to establish reliability. Pearson's product moment correlations for were .96 for the free recall. The free recall scores were used in the computation of various dependent variable scores used in subsequent analyses. The total recall score was computed by summing the values of all propositions. A precision/quality score was computed by dividing each participant's recall score by the total possible score. An amount/quantity score was computed by summing the number of correctly mentioned propositions. Propositions that corresponded to the main ideas were classified as macro propositions and propositions that corresponded to detail ideas were classified as micro propositions.

Analyses

The first analysis was conducted to replicate previous findings indicating that cooperative learning is more effective than individual learning, and to explore the locus of the impact of cooperation (primarily acquisition or retrieval processing). A group-type (dyads versus individuals) by recall (immediate versus delayed) factorial analysis of variance (ANOVA) was conducted. The total free-recall scores served as the dependent variable, and significant main effects were found for group-type (F (1,10) =6.77, p=.01 MSe=77.58 and recall (F (1,100) =16.77, p=.000, MSe=77.58). The two way interaction was not significant. Inspection of the means indicated that dyads had higher total recall

scores than did individuals (see Table 1). This finding concurs with previous studies that have found cooperation to result in better recall performance. Individuals and pairs who free-recalled the same information immediately after studying remembered more propositions than those individuals and pairs who free-recalled two days later; this finding is to be expected and will not be discussed further. The lack of a significant interaction indicates the differences between cooperative and individual groups were relatively constant across immediate and delayed recall. These particular findings suggest that the primary impact of cooperation is on acquisition since differences appear even when retrieval demands are low (i.e., during immediate recall).

The potential influence of cooperation on the quality and quantity of the recalled propositions was assessed. The dependent variable for quality was the precision of the recalled propositions and the variable for quantity was the amount of correctly mentioned propositions. Precision was assessed in a 2 x 2 group-type (dyads versus individuals) by recall (immediate versus delayed) factorial ANOVA which resulted in a significant effect for the recall factor $F(1,100)=7.40$, $p=.001$, $MSe=.022$) and no effects for group-type. Correct mentions was also assessed in a 2 x 2 factorial ANOVA with differences indicated for recall ($F(1,100)=31.86$, $p=.000$, $Mse=95.91$) and for group-type ($F(1,100)=4.99$, $p=.03$, $MSe=.95.91$). Again, one would anticipate that immediate recall would be superior to delayed recall. Examination of the means indicated dyads outperformed individuals on the quantity of propositions recalled (see Table 2). Although the quality was similar for the two groups, dyads remembered a greater number of correct statements.

The next step investigated the impact of cooperation on certain aspects of the material, i.e., the macro and micro propositions. A group-type (dyads versus individuals) by recall (immediate versus delayed) 2 x 2 factorial multivariate analysis of variance (MANOVA) was conducted. The results included multivariate differences for group-type, $F(2,99)=7.22$, $p=.001$, with significant univariate differences for the micro propositions, $F(1,101)=12.16$, $p=.000$, $MSe=110.58$. Examination of the means revealed that dyads outperformed the individuals in remembering details and that both groups performed similarly in recall of main ideas (see Table 3).

Significant differences were also found at the multivariate level for recall $F(2,99)=8.44$, $p=.000$ and at the univariate levels for both macro propositions $F(1,100)=10.72$, $p=.002$, $MSe=105.46$ and micro propositions $F(1,100)=12.69$, $p=.002$, $MSe=110.58$. Again, this was an expected finding. The two way interaction was not significant at multivariate or univariate levels.

Discussion

The results of the present study suggest that the "cooperative advantage" is not "across the board," but is limited to certain aspects of the learning-performance process. Compared to individual learning, scripted cooperation enhances (a) the acquisition or encoding of information and not retrieval, (b) the amount of information and not the accuracy or precision of the recalled information (consistent with the findings of Hall, et al., 1988), and (c) microstructure propositions and not macrostructure propositions.

The present finding that dyads recalled more details (microstructure) versus main ideas (macrostructure) contradicts the findings of Spurlin et al. (1984) mentioned earlier.

A possible explanation for this disparity is that the script instructions used in the Spurlin study placed an emphasis on main ideas by instructing the information presenter to give a "summary" and the listening/metacognizing partner to correct the "summary." There were no references to details in the instructions (Spurlin et al., 1984, p. 456). This potential bias was corrected in the current study through the use of "information" versus "summary" (in noun form) and the use of "presenting" versus "summarizing" (in verb form). It seems that with these more general instructions the partners are focusing on errors of omission during the cooperative interaction. Partners may be explicitly reminding each other of the details of the materials they are studying.

In summary, this study represents an attempt at a more comprehensive examination of the cognitive outcomes of cooperative interactions, and a first step toward a more precise investigation of the locus of the cooperative impact. Future research should confirm the locus of impact finding reported here and replicate the comprehensive analysis of cognitive outcomes with other cooperative scripts; replications and extensions of this experiment will provide a basis for predicting when cooperative activities will be effective, building more detailed models of cooperative learning, and for improving cooperative scenarios.

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Table 1

Means and Standard Deviations of Total Recall by Treatment Group

Group	M	SD
Dyads-Immediate	24.8	10.30
Individuals-Immediate	20.6	9.37
Dyads-Delayed	18.0	6.82
Individuals-Delayed	13.2	7.87

Table 2

Means and Standard Deviations of Quality and Quantity of Total Recall by Treatment Group

		Quality
Group	M	SD
Dyads-Immediate	.32	.03
Individuals-Immediate	.32	.03
Dyads-Delayed	.33	.04
Individuals-Delayed	.35	.06
		Quantity
Dyads-Immediate	31.60	10.54
Individuals-Immediate	28.21	11.84
Dyads-Delayed	21.60	7.22
Individuals-Delayed	16.38	8.94

Table 3

Means and Standard Deviations of Micro Propositions and Macro Propositions by Treatment Group

	Micro Propositions		Macro Propositions	
Group	M	SD	M	SD
Dyads-Immediate	28.14	12.52	18.77	11.39
Individuals-Immediate	20.14	10.60	21.29	12.07
Dyads-Delayed	19.98	8.11	14.41	8.90
Individuals-Delayed	13.83	9.81	11.99	8.26

Figure 1. Cooperative learning instructions.

General Procedure

In this cooperative learning episode, you and your partner will each play a particular 'role' to help you learn the material better. You both will begin with one of the roles and then switch halfway through the material. In this way you will have one turn at each role.

1. Decide which role each partner will play first in the interaction.
2. Silently read the material until you see "Stop Reading" in the text then put the materials away.
3. Begin the cooperative interaction with the Presenter talking first and the Listener/facilitator responding according to the explanations provided below.
4. After you have interacted as much as you can without referring to materials in the first section, you may look at your materials to supplement the information exchange.
5. When your interaction over the first section is finished, change roles and begin silently reading the section, repeating the same process you used in the first part of your interaction.
6. If there is time remaining at the end, talk over the entire passage with your partner.

Specific Roles and Activities

Presenter. The presenter orally presents the information to his or her partner. The information should be conveyed as clearly and comprehensively as possible. It may be best to assume that your partner has no materials to read, has never heard of the subject, and is therefore, completely dependent on you for all the knowledge that will gain.

Listener/Facilitator. This role has two functions. One is to be a questioning, naive learner and the other is to elaborate and correct the presenter's information. Act like a naive learner so you can ask good questions that will help clarify the information (It does not matter whether you know the answers to the questions or not). As a facilitator, your role is to ensure that as much information as possible will be learned by you and your partner. You should fill in any gaps left in the information, point out similarities and differences between parts of the information, and correct any errors.